

Original article

Trend of non-communicable disease mortality for three common conditions in the elderly population from 2002 to 2010: A population-based study in China

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Abstract

Objective: There is a lack of data focusing on non-communicable disease (NCD) mortality in the Chinese elderly population over the past decade.

Methods: Using mortality data from the Chinese Health Statistics, we explored the crude and age-standardized mortality trend of three major NCDs in the Chinese population ≥ 65 years of age from 2002 to 2010, namely, malignant neoplasms, heart diseases, and cerebrovascular diseases. Subpopulations characterized as rural and urban residence, and by gender and age were examined separately.

Results: Mortality increased with age and was higher among males than among females across the three NCDs, with the gender difference being most remarkable for malignant neoplasms and least for heart diseases mortality. Condition-specific crude mortalities increased between 2002 and 2010, overall and in all the pre-specified subpopulations. After age-standardization, rising trends were observed for people ≥ 65 years old, and condition-specific mortalities generally increased in rural regions and decreased in urban regions, especially for cerebrovascular diseases.

Conclusions: There were increasing trends for mortality due to malignant neoplasms, heart diseases, and cerebrovascular diseases in China between 2002 and 2010, which were largely driven by the population aging. Disparities existed by rural and urban residence, gender, and age.

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Keywords: Trend; Mortality; Elderly; Non-communicable disease

Introduction

Non-communicable diseases (NCDs) are loading a heavy burden onto global health, and account for nearly half of the disease burden in low-and-middle-income countries.¹ This trend along with the joined forces of an aging population, changes in diet, and less physical activity allies with inequality of accessibility to resources that may put the health care achievement of the Chinese government into uncertainty.^{2–4}

Mortality is important information for planning for and evaluating the health care infrastructure and is proposed by some as an indicator of economic success or failure.⁵ Unfortunately, prior to this study there has been a lack of reports focusing on NCDs mortality in the Chinese elderly population during the past ten years. Diseases of the heart, malignant neoplasms, and cerebrovascular diseases were reported to be the three most common causes of death in the Chinese population, followed by pneumonia and infectious diseases.⁶ In the current study, we looked into the mortality trend of the above three non-communicable conditions in Chinese citizens over 65 years of age from 2002 to 2010.

We used age, sex, and cause-specific mortality data from the largest and longest running Chinese health registration system administered by the National Health and Family Planning Commission (NHFP).⁷ This system samples about 10% of the Chinese population, amounting to 100 million residents, from different regions throughout China selected by the NHFPC. We used only the 2002–2010 mortality data because this data is coded in accordance with the 10th edition of the International Classification of Diseases (ICD-10). We then used this data to describe the temporal changes in the Chinese mortality of the three most common non-communicable diseases.

Methods

Data source and study population

Chinese Health Statistics (CHS) is released annually by the Health Statistics and Information Center of the NHFPC. The section of mortality statistics in CHS has

been derived from death certificate data collected through the Cause of Death Registration System (CDRS) in China. CDRS has been described in details elsewhere.^{8,9} In brief, the registration system covers about 10% of the Chinese population, amounting to 100 million residents, from affluent regions and surrounding rural areas selected by the NHFPC. During the period of 2002–2010, ICD-10 was used to identify mortality causes for the vital statistics, and 20 conditions were listed as potential contributing causes of death. We restricted our study population to people ≥ 65 years old.

Statistical analyses

In the current study, people with malignant neoplasms, heart diseases, or cerebrovascular diseases listed as the underlying or contributing cause of death. Stratum-specific mortality rates (per 100 000) are reported annually in the CHS, by residence (rural/urban), gender (male/female), and age (65–84 by every 5 years, and ≥ 85 years). The corresponding size of the population in each stratum was derived from the whole-country census data (for the years 2000 and 2010) or the annual national population composition estimates (for other study years) released from the National Bureau of Statistics of China (<http://www.stats.gov.cn/tjsj/ndsj/>). To calculate the crude mortality rate due to each condition in different sub-populations characterized by rural/urban residence, gender, or age categories, we used the estimated size of the subpopulation as the denominator in that year. The numerator was calculated first by multiplying the stratum-specific mortality rate by the population size in each corresponding stratum, then the products were summed as the total number of deaths in that sub-population. To disentangle the effect of population aging, we also calculated the age-standardized mortality rates, overall and in all subgroups, using the World Health Organization (WHO) standard population age-structure for the time period 2000–2025.¹⁰

We fitted a Poisson generalized linear model with age, gender, residence (rural or urban), calendar year, and the interaction terms of calendar year with residence and gender as variables. The multivariate-

adjusted incidence rate ratios (IRR) and the corresponding 95% confidence intervals (CIs) were estimated. All statistical testing was 2-sided, had a significance level of 0.05, and all analyses were conducted using SAS 9.3 version (SAS Institute Inc, Cary, North Carolina). The authors had full access to and take full responsibility for the integrity of the data. The Fuwai Cardiovascular Hospital Institutional Review Board has reviewed and approved the study.

Results

The crude mortality rates for the three conditions accounted for 42.8% of all-cause mortality in 2002 and for 57.7% in 2010. In 2002, malignant neoplasms, heart diseases and cerebrovascular diseases accounted for 17.4%, 11.5%, and 13.9% of all-cause mortality, respectively. The corresponding numbers were 22.0%, 16.6%, and 19.1% in 2010. In the age-standardized analyses, the three NCDs accounted for 54.5% of all-cause mortality in 2002 and 67.2% in 2010. All three conditions increased in similar proportions.

As expected, crude mortality in ≥ 65 age group remained at a much higher rate throughout the study period (Fig. 1, Table 1). Consistency with the gender-specific trend, rising trends were observed in the mortalities of both genders among the elderly. At all

Table 1

Crude mortality (1/100 000) of three major non-communicable diseases, Chinese cause of death registration system, 2002–2010.

Conditions	2002	2003	2004	2005	2006	2007	2008	2009	2010
Malignant neoplasms									
Overall	127	200	187	180	201	219	217	218	209
Rural	112	207	195	167	201	224	240	236	210
Urban	151	190	175	197	201	212	190	197	207
Female	89	144	131	127	136	148	148	150	142
Male	208	256	243	233	267	291	288	286	276
≥ 65 years	610	864	829	777	884	945	954	950	948
Heart diseases									
Overall	108	135	111	124	116	120	127	153	169
Rural	117	131	96	100	107	129	127	163	172
Urban	93	140	130	156	127	109	126	141	165
Female	104	131	107	123	107	108	114	137	153
Male	112	138	114	125	124	132	139	169	185
≥ 65 years	825	876	730	808	732	751	787	962	1078
Cerebrovascular diseases									
Overall	130	165	153	179	143	155	165	183	194
Rural	142	171	171	180	159	181	197	221	224
Urban	110	157	129	177	124	122	127	139	160
Female	115	146	136	165	124	132	143	157	165
Male	144	185	171	194	163	178	188	209	223
≥ 65 years	977	1056	1001	1132	888	958	1034	1137	1211

time points, male mortality was higher than female mortality across the three conditions. As for the rural-urban comparisons, there was a decrease in cerebrovascular diseases mortality among the urban elderly

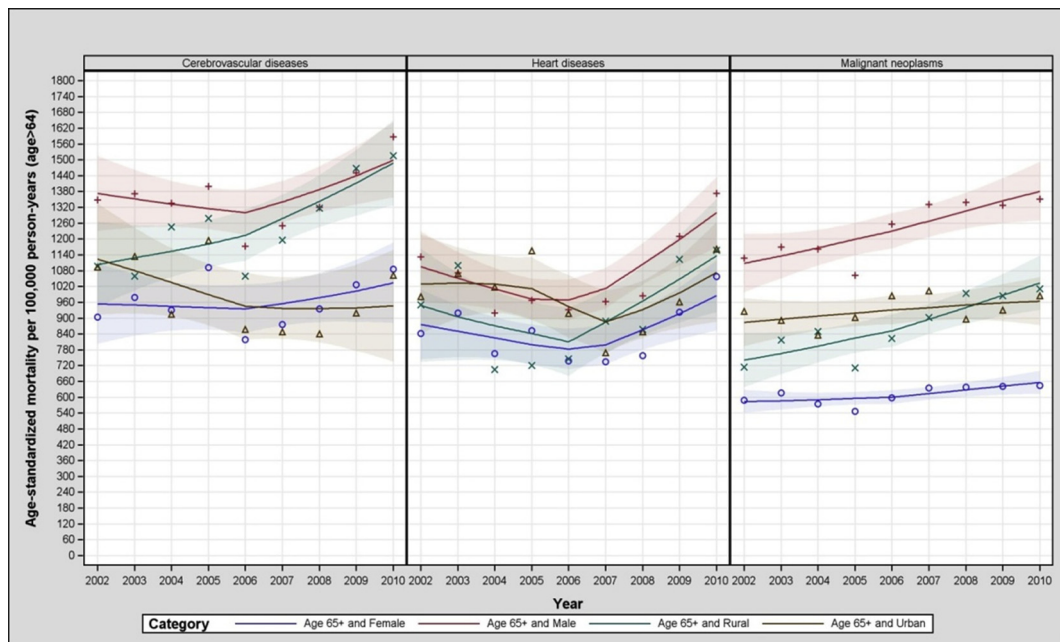


Fig. 1. Trends by region and gender specific age standardized mortality of three major non-communicable diseases in people aged ≥ 65 years, Chinese cause of death registration system, 2002–2010.

but an increase observed in the rural elderly (from 988 per 100 000 in 2002 to 1405 per 100 000 in 2010 with a relative increase of 42.2%). Among people aged ≥ 65 years, malignant neoplasms and heart disease mortality for rural residents also surpassed those for urban residents during the study period. After further age-standardization by 5-year age categories, the patterns of different mortality trends for the populations of age < 65 years and ≥ 65 years changed little (Fig. 1, Table 1).

In the multivariate model, advanced age and male gender were risk factors for mortality due to all three conditions (Table 1). The rural-urban discrepancies were consistent with the graphic descriptions above. Specifically, for the mortality rate due to cerebrovascular diseases, there was a 2.0% annual increase in rural females, a 2.4% increase in rural males, a 2.6% decrease in urban females, and a 2.9% decrease in urban males. For heart diseases, every year there was a 2.0% increase in rural females, a 3.6% increase in rural males, a 1.5% decrease in urban females, and a 0.3% decrease in urban males. For malignant neoplasms, the annual change was a 4.8% increase in rural females, a

2.5% increase in rural males, a 2.3% increase in urban females, and a 2.1% decrease in urban males (Table 2).

Discussion

Consistent and comparative description of mortalities and their associated risk factors are quite important for decision-making and planning processes in providing health care. Although urgently needed, such information is lacking in China. In the current study, we found that: all of the three leading causes of death for Chinese population, namely, diseases of heart, malignant neoplasms, and cerebrovascular diseases, increased dramatically in the Chinese population older than 65 years of age from 2002 to 2010. Mainly driven by diseases of the heart and cerebrovascular diseases, disparities between urban and rural areas were obvious in terms of NCD mortality. However, after age-standardization, the corresponding rates increased to a much smaller extent, or remained unchanged or even decreased in some subpopulations.

This is compatible with a previous study based on WHO data that revealed no meaningful variation in cardiovascular diseases and cancer age-standardized mortality rates for China in the recent decade.¹¹ Population aging is a critical social problem facing China and it is known that age is a dominating factor for the epidemiology of NCDs.^{12,13} If the current trends continue, it is projected that the proportion of people ≥ 65 years old in the Chinese population will double from 7% in 2000 to 14% in 2030,¹⁴ and reach almost 20% in 2040.¹⁵ Notably, we found that the mortalities due to the three NCDs in people aged ≥ 65 years were substantially higher and there were rising trends even after age standardization across all three conditions. With the aggregation of age groups (e.g. ≥ 85 years) in both the mortality statistics and the WHO standard population structure, there might be an increasing mean age over time and inadequate age standardization among the elderly, which contributes to the observation of rising trends in this subpopulation.

Based on the aging of the population alone, Chinese cardiovascular disease (CVD) is predicted to increase by 200% between 2000 and 2040.¹⁵ In accordance with the above estimates, we found that there was a rising mortality trend across all three non-communicable conditions in people 70 years or older. As is known, an aging population is one of the major factors dominating the epidemiology of NCDs. In 2000, the proportion of Chinese population aged 65 years or older was around 7%,¹⁶ but will have reached nearly 20% by 2040 if the current trends continue.¹⁵ As life

Table 2
Factors associated with mortality of three major non-communicable diseases, Chinese cause of death registration system, 2002–2010.

Factors	Incidence rate ratio (95% confidence interval)
Cerebrovascular diseases	
Five-year increase in age	1.8380 (1.8377, 1.8384)
Male	1.4845 (1.4814, 1.4875)
Urban	0.9542 (0.9521, 0.9563)
Calendar year	
In rural females	1.0203 (1.0200, 1.0207)
In rural males	1.0243 (1.0240, 1.0247)
In urban females	0.9738 (0.9734, 0.9742)
In urban males	0.9706 (0.9703, 0.9710)
Heart diseases	
Five-year increase in age	1.8737 (1.8731, 1.8742)
Male	1.2562 (1.2532, 1.2592)
Urban	1.2380 (1.2350, 1.2410)
Calendar year	
In rural females	1.0201 (1.0197, 1.0206)
In rural males	1.0357 (1.0353, 1.0361)
In urban females	0.9853 (0.9849, 0.9858)
In urban males	0.9970 (0.9965, 0.9974)
Malignant neoplasms	
Five-year increase in age	1.4777 (1.4774, 1.4779)
Male	2.4540 (2.4490, 2.4591)
Urban	1.1430 (1.1408, 1.1452)
Calendar year	
In rural females	1.0478 (1.0474, 1.0482)
In rural males	1.0247 (1.0244, 1.0250)
In urban females	1.0234 (1.0230, 1.0238)
In urban males	0.9793 (0.9790, 0.9797)

expectancy increases, it is important to both quantify and understand determinants of aging-related mortality trends so as to inform the timing of interventions and encourage the development of educational strategies. Reinforced community-based intervention and increased public awareness might explain this observation. However, owing to the growing risk profile among the Asian population^{17–21} and the important role the younger generation plays in social production,²² control of premature deaths from NCDs should still be one of the primary functions of the Chinese health care system.

One of the advantages of non-communicable disease control is that various conditions share similar risk profiles among which modifiable risk factors could explain up to 80% of the global risk.^{23–27} In the current study, we were unable to capture the strength of all the risk factors but we found that living in rural areas and smoking were significantly associated with increased mortality from both heart diseases and cerebrovascular diseases. Smoking control and strengthening of the health care infrastructure in rural areas should be the targets for CVD intervention in China. However, the urban/rural disparities and increased cigarette production could not explain the increased cancer mortality from 2002 to 2010 in China. It is possible that similar risk factors might act differently in driving the epidemic of CVD or cancer. It is also possible that cancer attracts more attention from the public and the government, and therefore receives more intensive interventions. To some extent, cancer control took the lead in NCD control in China: the first Chinese cancer registry can be traced back to as early as 1963,²⁸ while it was not until 1990s when a community-based trial for diabetes and hypertension management was launched.²⁹

Unlike vertical disease-control programs yielding separate and poorly coordinated data-collection efforts, civil registration generates routine, representative and continuous mortality data³⁰; provides that the system fulfills the criteria of generalizability, reliability, validity, and policy relevance.³¹ The temporal trend described in the current study might not be representative of that at the national level because the selected areas were those with a better socioeconomic situation and health care services. However, up until now, this registry is the best available program providing vital statistics representing over 100 million citizens across 25 Chinese provinces and municipal cities. The changing rate might differ between areas in and outside the registry but the direction of the trends should be similar. The vital statistics information was reliably

and accurately collected because of a complete residence registration system, regular census representation of the nation, and improvement in diagnoses and classification. Although under-reporting of deaths occurred it usually happened in remote areas and for children younger than 5 years of age, while deaths in large cities were completely recorded.

The temporal trend of the three non-communicable conditions observed from 2002 to 2010 has important implications for deciding the priority of the health care program and scaling up interventions for NCDs in China. Aging, urban/rural disparities, and smoking are driving the epidemics but it is an enormous challenge to control the risk factors. Effective strategies should include both government efforts to increase capacity for national level disease control programs and community collaboration to foster a health environment for non-communicable disease preventions.

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